

Scientific news from the
Washington ACS meeting

A1250-1

Biomass

Abundant, renewable
resource for advanced
materials, chemicals
Page 19

News of the Week

■ A fuel leak again grounds space shuttle *Columbia* and delays *Astro-1*, a spacelab mission designed to make round-the-clock observations with UV and x-ray telescopes.

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■ Scientists isolate a gene mutation that is responsible for a common form of osteoarthritis.

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■ ACS files countersuit against Dialog seeking \$40 million in damages for breach of contract, breach of obligation of good faith, and fraud.

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■ Delegates to UN-sponsored conference agree to draft assessment as step toward treaty aimed at halting global warming.

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■ Argonne researchers devise chemical process for extracting, recovering ^{90}Sr from liquid nuclear wastes.

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Cover: Photo by Royce Bair,
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Business

Chemicals have become a big part of Shell's business, boosting it to the seventh largest chemical firm in the world.

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Government

Less use of fossil energy and more funding of energy-related R&D were called for recently both by participants at an ACS press conference on responses to the Mideast situation and in a report from the National Research Council.

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Science/Technology

From the Washington meeting: new technique for formation of nanomaterials developed; all-organic, optically clear, solid-matrix, radioluminescent lights developed by Sandia chemists; scanning tunneling microscopy images of lysozym and chymotrypsinogen A deposited on graphite surfaces reveal protein molecules in ordered arrays.

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ACS News

People and events from national meeting are shown in photos; more PRF grants approved.

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Cover Story

Resurgence of interest in producing new materials, chemicals, and fuels from biomass resources sparks active R&D efforts, but greater federal commitment is urged.

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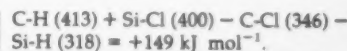
LETTERS

CHEMICAL SAFETY

Explosion hazard for chloroalkyl silanes

The letters from Keith A. Horn (C&EN, June 4, page 2) and Jonathan D. Rich (C&EN, March 26, page 2) prompt me to call attention to related observations of explosion hazards for chloromethyl silanes [Kaes, H. D., Stone, F. G. A., *J. Chem. Soc.*, 1433 (1957)].

The exchange of each mole of C-Cl bond with one mole of Si-H bond is exothermic. Bond enthalpies (in kJ mol⁻¹) [from Johnson, D. A., "Some Thermodynamic Aspects of Inorganic Chemistry," 2nd ed., Cambridge University Press, New York (1982)] are:



Lewis acids are known to catalyze this process, which when intramolecular is known as the Whitmore rearrangement. Thus the hazard of an exotherm exists for any haloalkyl silane, and not just for the cases cited in the above-mentioned letters. The bumper-sticker equivalent of "I Brake for Trees" for chemists involved in synthesis should be, "I Brake for Thermodynamics."

Herbert D. Kaes

University of California, Los Angeles

Misuse of homochiral

We want to commend Stu Borman on the timely and important article, "Chirality Emerges as Key Issue in Pharmaceutical Research" (C&EN, July 9, page 9), which alerts your readers to a current problem of considerable interest. Unfortunately, however, the widespread misuse of the term "homochiral" in the sense of "enantiomerically pure" was propagated in this article, despite concern previously voiced in this column (C&EN, Nov. 4, 1985, page 5) and despite the fact that the editor of the *Journal of Organic Chemistry* frowns on this misuse of the term.

The term homochiral was coined by W. Thomson (later Lord Kelvin) in his Baltimore Lectures (1884, published 1904). It is derived from the Greek "homos," which means same, and "cheir," which means hand, and thus means objects or molecules of the same handedness (or sense of chirality or configuration). Thus left hands (of different individuals) are homochiral as are molecules of (+)-tartaric acid. A sample of (+)-tartaric acid is made up of homochiral molecules, but it is inappropriate to therefore call the sample (or the substance) homochiral just as one does not call a notepad "identical" just because it is made up of identical sheets of paper.

The appropriate term to use for a configurationally homogeneous sample—i.e., one made up of chiral molecules of one and the same configuration—is "enantiomerically pure"—a term, in

fact, repeatedly and correctly used in the above article. If a single word is preferred, we propose the abbreviated form "enantiopure."

Ernest L. Eliel

Samuel H. Wilen

University of North Carolina

ACS and UNESCO

I noted in a Government Concentrate (C&EN, June 4, page 14) that our society sent a letter to President Bush and Secretary of State James Baker saying that it was "crucial that the U.S. return to ... the United Nations Educational, Scientific & Cultural Organization and fund it ... at the level the U.S. provided ... in 1981."

I have written letters to President Bush and Secretary Baker informing them that this action was not taken with the concurrence of the membership and over what would have been some protest. The U.S. rightly withdrew from UNESCO in 1981 after it became obvious that the organization had degenerated into an anti-U.S. and anti-Western World propaganda instrument. Even with a change of director-general, the stance has only slightly changed (from violent anti-Americanism to only strident anti-Americanism)! One does not fund one's enemies.

In my 23 years of ACS membership, I have noted a distinct political shift of the organization to the political left. This is most unfortunate. ACS should

More Energy Research Called for To Stem Oil, Climate Change Crises

ACS press conferees, National Research Council report agree—meet crises by using less fossil energy and spending more on energy R&D

Janice R. Long, C&EN Washington

Oil in particular and fossil fuels in general were the topic of much discussion in Washington, D.C., during the last week in August. At the 200th national meeting of the American Chemical Society, participants in a press conference pulled together by the ACS News Service addressed the question of appropriate responses to the looming energy crisis posed by the Mideast situation.

Meanwhile, the National Research Council, responding to a request from Congress and with funding from the Department of Energy, issued a report assessing what energy policies and R&D strategies the U.S. might pursue if it decided that stabilizing atmospheric concentrations of so-called greenhouse gases, which seem to contribute to global climate change, were wise courses of action.

Both groups came up with the same answers to what, on the face of it, might seem to be two very dissimilar problems: Put more, a lot more, research emphasis on renewable energy sources, improved methods of employing fossil fuels, energy conservation, and energy efficient technologies. Those, however, are long-term answers. In the short term, the best answer to both problems, both groups agree, is to use less fossil energy.

The NRC Committee on Alternative Energy Research & Development Strategies emphasizes the importance of conservation or more ef-

ficient use of fossil fuels as the best near-term (from the year 1990 to 2000) way to reduce emissions of carbon dioxide and other greenhouse gases. In that time, the committee says, R&D can have little effect on the adoption of greenhouse-gas-reducing technologies that already exist but are not currently used.

Incentives and regulations by the federal government—such as taxes, tax credits, energy efficiency standards, loan guarantees, subsidies, and liability limitations—can have major influence. "In the event that the nation makes a commitment to reduce emissions of [greenhouse gases] significantly, such actions ought to be considered" as a supplement to the two R&D strategies laid out in its report, the committee says.

The first or "focused" R&D strategy involves pursuing energy R&D that, although aimed at reducing greenhouse gas emissions, also makes sense for reasons other than a concern about global climate change. The second or "insurance" strategy calls for pursuing energy R&D that would be viable only in the presence of concerns about global climate change. In both strategies, the report says, federal funding is needed because of the inability of private firms to capture the benefits of basic research and because the price of fossil fuels is less than the full cost to society associated with their use.

Either program would require a major change in emphasis in DOE's energy R&D programs, because, as the committee says, "only limited investments are being made in technologies relevant to the reduction of [greenhouse gas] emissions." For example, the report points out that federal funding for DOE's civilian energy R&D in the solar and renewables program fell 89% on a constant-dollar basis from fiscal 1979 to

fiscal 1989. During the same time, conservation program funding declined 61% and electric energy program funding 76%.

Thus as a first step, the committee recommends DOE reallocate \$300 million in funds on a sustained basis to research programs aimed at increasing energy productivity by achieving high levels of energy efficiency in electricity generation and in buildings and transportation; increasing recycling of materials; and gaining a better understanding of processes involving biomass production and conversion—to name just a few. In addition the committee says research is needed to foster the development of and shift to the use of low or nongreenhouse-gas-emitting energy technologies.

Many of the changes in DOE's research emphasis suggested in the NRC report, "Confronting Climate Change: Strategies for Energy Research & Development," would also work to lessen the U.S. dependence on foreign oil, which was discussed at the ACS news conference. As James L. Gaddy, distinguished professor of chemical engineering at the University of Arkansas, pointed out, the U.S. decided 15 years ago that it would be energy self-sufficient by 1990. That effort was "not very successful," according to Gaddy, noting that in 1975 the U.S. imported 30% of the crude oil it consumed. Imports now account for 54% of oil used.

It's not that the U.S. suffers from a lack of energy sources, Gaddy notes; it has plenty of coal reserves. "What we are short of in this country are liquid fuels. We need transportation fuels." His solution to energy shortages focuses on both renewable energy sources and improved methods of employing fossil fuels. Gaddy points out work—also the subject of

a paper presented at an ACS Division of Fuel Chemistry symposium—that he and his colleagues are doing on the biological production of liquid fuels from biomass and coal. They have microorganisms, he says, that can produce ethanol from biomass, convert natural gas into ethanol, and convert gasified coal into liquid fuels.

These microorganisms, Gaddy says, are very energy efficient. They work at ordinary temperatures and pressures and so offer significant advantages over chemical processes used to produce liquid fuels from coal. These chemical processes are too expensive to compete with oil-based fuels, even at today's relatively high prices. Gaddy, whose work has been supported by DOE, thinks that biological conversion can be done economically now that its technical feasibility has been established on a small scale. What's needed now, he says, are large-scale demonstrations, which could take four to five years. The problem, he adds, is finding the money to do the scaleup.

The medium-term solution to potential energy shortages offered at the ACS press conference by Douglas G. Naeae, a research scientist for Texaco's exploration and production technology division in Houston, focuses on using a renewable resource—lignin—to recover a nonrenewable resource—oil. Naeae points out that the U.S. consumes about 16 million barrels of oil each day, with about half of that coming from domestic wells. Based on today's prices and using today's technology, he

says, the supply from currently operating U.S. wells will last about eight to nine years.

However, Naeae says, and further indicated in a paper given at a symposium for the ACS Division of Cellulose, Paper & Textile Chemistry, the U.S. could add the equivalent of 50 years' supply, or 150 billion bbl, to its reserves using chemical flooding technology, which uses surfactants to flush the oil in underground reservoirs to production wells so it can be pumped to the surface. It has been known for some time that the process, called enhanced oil recovery, works. However, it's generally been just too expensive to use this process because of the high prices and limited quantities of the necessary chemicals. An oil price of \$35 to \$40 per bbl is needed to make enhanced recovery profitable, according to Naeae.

Given the situation in the Middle East, prices may go that high. However, the technology being developed by Texaco is much more economical, Naeae says, because it starts with lignin-based chemicals. Lignins are produced in large quantities, approximately 250 billion lb per year in the U.S., as by-products of the pulp and paper industry. As a consequence, the price of some lignin products, such as lignosulfonates, are as low as 2 cents per lb. Although lignin chemicals have many applications, such as in drilling muds, as binders for animal feed, and as the base for artificial vanilla, Naeae says they have not previously been used as surfactants for oil recovery.

According to Naeae, lignin chemicals can be used in two ways in chemical floods for enhanced oil recovery. In one method, lignosulfonates are blended with tallow amine and conventional petroleum sulfonates to form a unique mixture that costs about 40% less to use than chemicals made solely from petroleum or petroleum-based products.

In a second method, the lignin is reacted with either hydrogen or carbon monoxide to form a new class of chemicals called lignin phenols. These phenols, because they are soluble in organic solvents, but not in water, are good candidates for further conversion to chemicals useful in enhanced oil recovery, he says.

Christopher Flavin, vice president for research at the Worldwatch Institute and speaker at a symposium sponsored by the ACS Division of Environmental Chemistry, took a different tack from the other two speakers at the ACS press conference. He says it is important to keep in mind, when viewing the impending oil crisis in the Mideast, that it is the U.S.'s own increased consumption of oil that has gotten it once again into a potentially precarious situation. Flavin contends that finding strategies to restrain U.S. consumption of oil would be a much more economical strategy over the next 10 years than one relying on alternative energy sources, such as synthetic fuels. Such fuels were touted 15 years ago but proved to cost much more than people were willing to pay in times of relatively cheap energy. And conservation is a viable option, he maintains, pointing out that the technology to produce cars with fuel efficiencies of 40 miles per gallon is available now. If all cars got that mileage, the U.S. could be saving 3 million bbl of oil per day by 2000.

Flavin also notes that the energy industry, be it conventional or alternative, is facing very different environmental requirements and conditions from those that existed during the previous energy crises. For example, given the need to worry about carbon dioxide emissions, Flavin says, developing synthetic fuels would be a disastrous course to follow—even if they proved to be economical, from an environmental point of view. □

Energy R&D budget is half of what it was after '70s crises

\$ Millions*	1989	1979	% change 1979-89
Fossil energy	\$ 528	\$1035	-49%
Basic & supporting research	438	297	47
Magnetic fusion	305	327	-7
Nuclear fission	293	1356	-78
Biological & environmental research	217	302	-28
Conservation	135	350	-61
Uranium enrichment	115	203	-43
Solar & other renewables	105	929	-89
Energy Information Administration	63	61	3
Electric energy	36	147	-76
TOTAL	\$2235	\$5007	-55%

* Constant 1989 dollars. Note: Excludes funding for DOE's general science programs, human genome project, and Superconducting Super Collider project. Source: National Research Council.